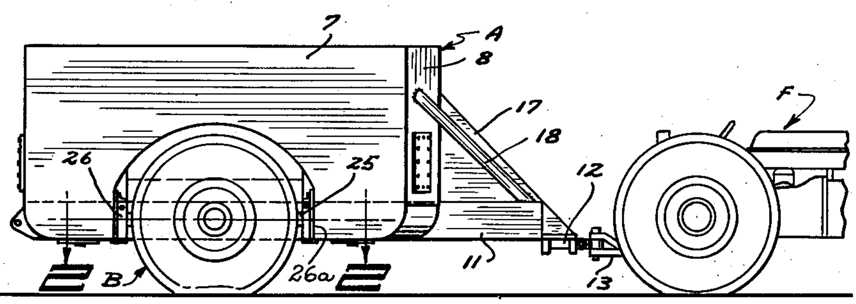
Sept. 16, 1952 C. W. BROS ET AL 2,610,557

PNEUMATIC ROLLER COMPACTOR

Filed Nov. 17, 1949 3 Sheets-Sheet 1

FIG. 1



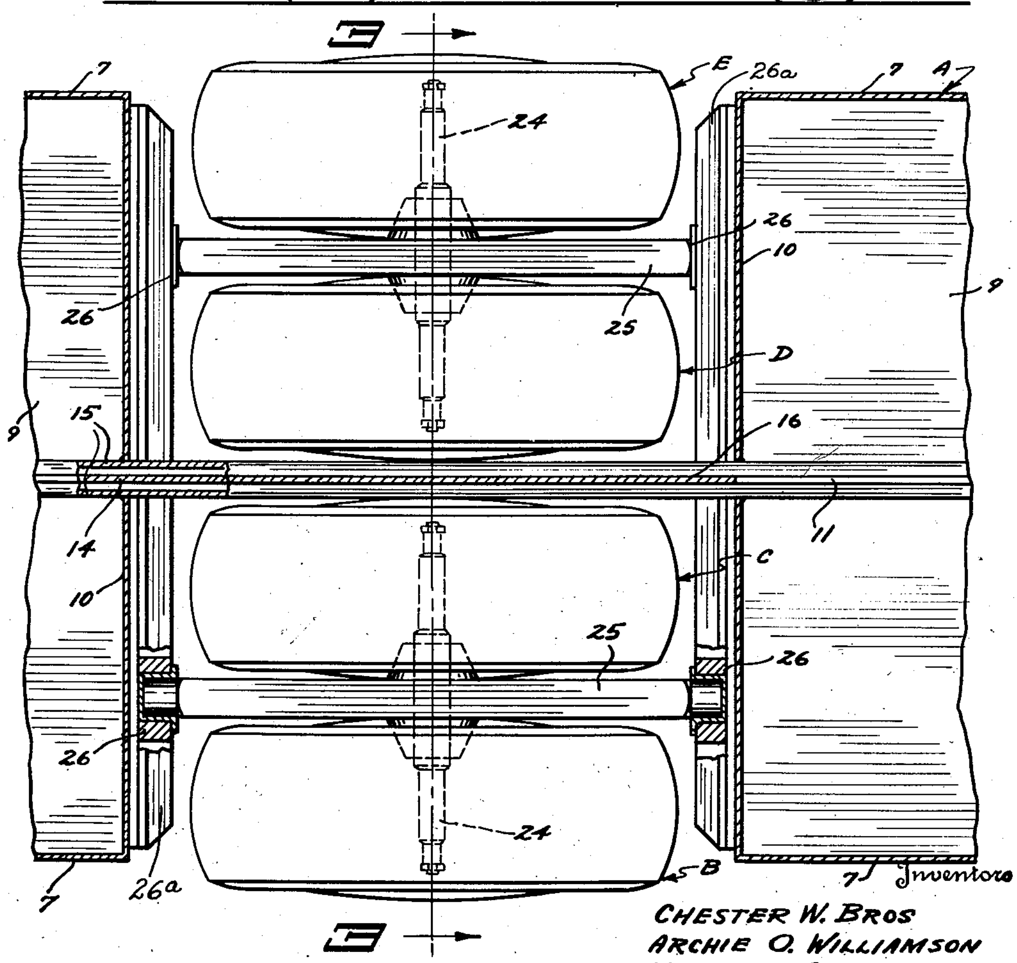


FIG. 2

Inventors
CHESTER W. BROS
ARCHIE O. WILLIAMSON
ULYSS O. GUIGNARD

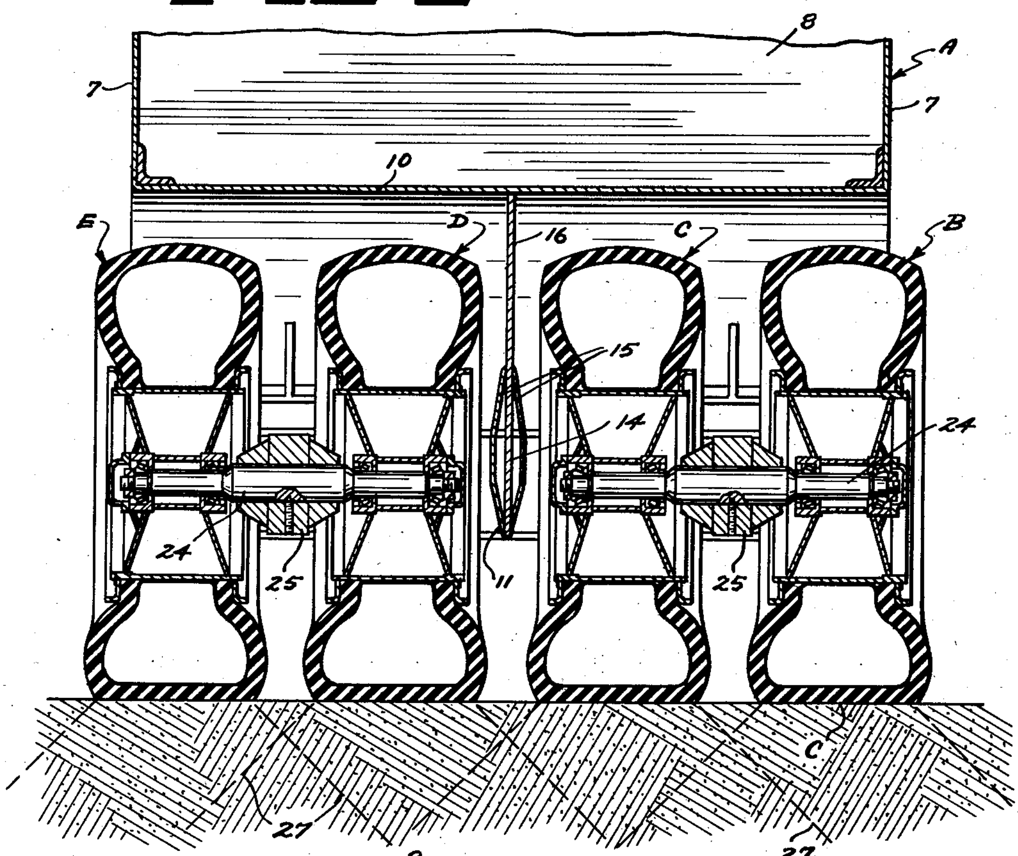
By Carlsen & Hagle
Attorneys

Sept. 16, 1952 C. W. BROS ET AL 2,610,557

PNEUMATIC ROLLER COMPACTOR

Filed Nov. 17, 1949 3 Sheets-Sheet 2

FIG 3



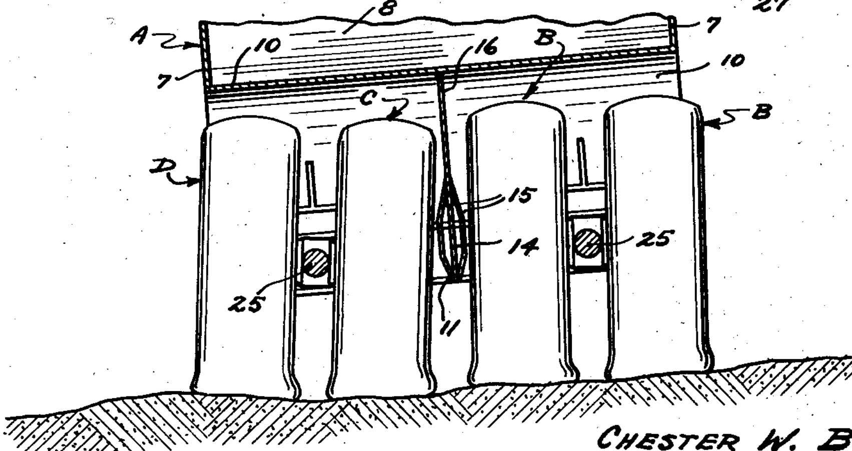


FIG 4

Inventors

CHESTER W. BROS
ARCHIE O. WILLIAMSON
ULYSS O. GUIGNARD

By Clarence A. O'Brien & Harvey B. Jacobson (signature)

Attorneys

Sept. 16, 1952 | C. W. BROS ET AL | 2,610,557

PNEUMATIC ROLLER COMPACTOR

Filed Nov. 17, 1949 | 3 Sheets-Sheet 3

FIG 5

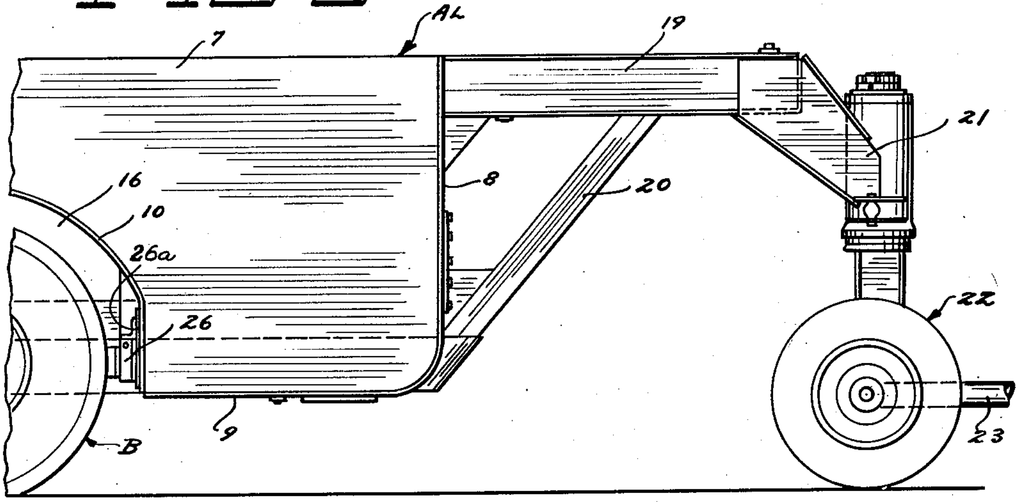
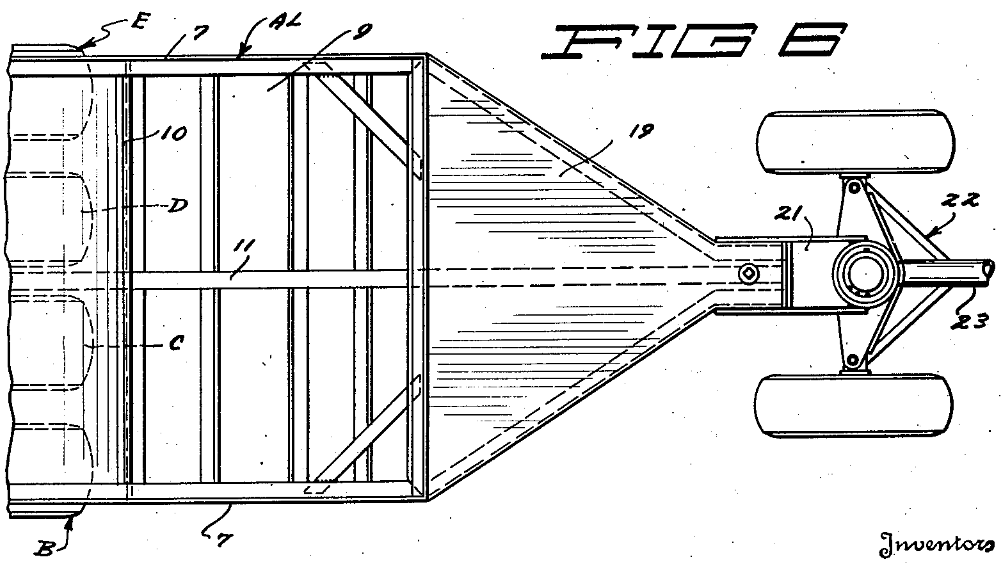


FIG 6



Inventors

CHESTER W. BROS
ARCHIE O. WILLIAMSON
ULYSS O. GUIGNARD

By Carlsen & Hagle
Attorneys

Patented Sept. 16, 1952

2,610,557

UNITED STATES PATENT OFFICE

2,610,557

PNEUMATIC ROLLER COMPACTOR

Chester W. Bros, Archie O. Williamson, and Ulyss O. Guignard, Minneapolis, Minn., assignors to Wm. Bros. Boiler and Manufacturing Company, Minneapolis, Minn., a corporation of Minnesota

Application November 17, 1949, Serial No. 127,865

4 Claims. (Cl. 94—50)

1

This invention relates to the art of compacting earth for roads, highways, airport runways, fills for dams, etc. where deep penetration and uniform but maximum density are important objectives, and the primary purpose is to provide a novel, efficient and practical pneumatic tired compactor that will effectively yet economically meet these rigid objectives or requirements.

Soil stabilization and compaction problems are not new and have been efficiently solved in many instances and by various means. But with increased demands resulting from modern heavy traffic and load conditions the problem becomes more acute and critical, because unless the foundation soil structures are compacted or compressed by equipment at least as heavy as that which is to subsequently travel thereover there will be additional and irregular compaction and consolidation that will injuriously disrupt the surface condition that was prepared for such subsequent traffic.

A typical exigency is that represented by airport runways which must receive and support aircraft weighing as much as three hundred thousand pounds. The impact thus resulting, in effect, from wheel loads of one hundred fifty thousand pounds is such as to break down the runway pavement unless it is properly supported by base courses and subgrades that have been compacted to an extremely high degree of density and to a depth of as much as five to six feet below the surface.

The advantages resulting from the use of pneumatic tired compaction rollers have been recognized for some time. They produce a kneading and densification action, irrespective of ground surface irregularities, that is far superior to that obtained by hard steel rollers, regardless of size or weight.

It is also evident that the depth of pressure penetration and the degree of subgrade density will be increased by using larger tires and imposing heavier loads. It is found, however, that the problem cannot be solved by merely increasing size and weight of existing rollers because a number of practical and operational considerations intervene. These include, body rigidity, transport, maneuverability, cost, available tire and tractor power limitations, safety, weight concentration, and other important factors.

To obtain the required depth and density compaction loaded rollers of thirty-five to two hundred tons in weight are desirable. To be effective, this enormous weight must be applied over a relatively limited ground surface area, to pre-

2

vent dissipation or lateral dispersion of the vertical pressures, and must also be uniformly distributed at all times to be supporting wheels so that no one of them will be subjected to weight pressure beyond which its pneumatic tire will support without blowing out. These tires must necessarily be of giant size, represent a very substantial investment, and their replacement or repair is accordingly an important item in the construction and maintenance cost of this equipment.

With the foregoing and other practical problems and technical difficulties in mind, we have developed and perfected a pneumatic tired compactor which has been thoroughly tested and found extremely practical and efficient in actual use. This machine is exemplified in the accompanying drawings, wherein—

Fig. 1 is a side elevation of a preferred form of our compactor showing it directly connected to a tractor.

Fig. 2 is an enlarged sectional plan view on the line 2—2 in Fig. 1.

Fig. 3 is a cross sectional elevation on the line 3—3 in Fig. 2.

Fig. 4 is an elevation, partly in cross section, showing the body and wheels in tilted positions as when travelling over an irregular surface.

Fig. 5 shows a modified form of machine in this instance the main body having a forward goose-neck draft structure for mounting on a dolly which is in turn connected to the pulling tractor.

Fig. 6 is a plan view of the structure shown in Fig. 5.

Referring to the drawings more particularly and by reference characters A (Figs. 1–4) designates a large steel box which forms the main body structure of the machine. This box is substantially rectangular, in plan, but in side elevation has an arched, transversely extended recess for the reception of the supporting wheels B, C, D and E. This results in deep wells, at fore and aft ends of the box, and the distribution of weight including ballast loaded into the box, is such that the center of gravity is directly over or slightly forward of the wheel axis so as to impose maximum load pressure on the tires.

When the machine is in operation it is loaded with ballast, such as wet sand, until the total weight approximates or exceeds thirty-five tons, with a result that the box is subjected to very great torsional and twisting stresses, particularly when moving over irregular terrain. To counteract these stresses and to provide a maximum degree of body rigidity and design and construction of the body proper becomes an important problem.

In the structure illustrated in Figs. 1–4, the body box is made up of heavy steel plate side, end and bottom walls **7**, **8** and **9**, respectively, all securely welded together, and a similarly secured arched bottom plate **10**, over the wheels.

A draft beam **11** extends centrally and longitudinally through the entire length of the bottom of the box and forwardly therebeyond (Fig. 1) to a universal coupling **12** that connects it to the drawbar **13** of the tractor F. This draft beam may be of any substantial steel design, but is preferably narrow in width, and in the present instance comprises a center plate **14** and a pair of transversely curved or concaved side plates **15**, all welded into a single rigid unit. This beam is also rigidly secured, preferably by welding, to the end walls **8**, to the bottom wall **9**, and to the vertical lower portions of the arched bottom plate **10**. It will be seen that it connects these portions **10** (Fig. 2) by extending across the wheel recess, between the wheels C and D, so as to transmit the draft force directly to the rear of the box, but is sufficiently narrow, and in the transverse horizontal plane of the wheel axes, so as to permit the wheels C and D to be closely spaced with respect to each other. This position of the center beam is also such as to not interfere with the wheel unit oscillations as will presently be set forth.

It will also be noted that the upper arched portion of the plate **10** is reinforced by a generally semi-circular plate **16** which may be an integral extension of the beam **11** which extends forwardly beyond the box A is further rigidly connected to the forward wall **8** by a center gusset plate **17** and upwardly and outwardly diagonally extended brace bars **18**.

In the modification shown in Figs. 5 and 6, the box A1, is substantially similar to the box A, except that the beam **11** does not extend directly forwardly to the draft vehicle. In this instance the roller has a generally goose-necked draft connection in the form of a hollow beam **19**, which is triangular in plan and extends forwardly from the upper part of the box A1. This beam is then connected to the draft beam **11** by an inclined beam **20**, and terminates in a casting **21** pivotally mounted on a two-wheeled dolly **22**. The dolly thus forms an independent support for the roller and is merely connected to the tractor by a conventional draft tongue **23**.

Returning now to the more critical wheel and tire construction, arrangement and function, it will be seen that the wheels are arranged in coaxially aligned pairs, the wheels of each pair being mounted on opposite ends of a shaft **24** the middle of which extends through and is rigidly secured in a fore-and-aft extending beam **25**. The ends of the beams **25** are oscillatably mounted in opposed bearings **26** in transversely extending bearing beams **26a** rigidly secured to the lower ends of the recess wall **10**. The beams **25** in addition to mounting the shafts **24** operate to maintain parallelism between the lower ends of the recess wall **10**, retain proper spacing between said lower ends and cooperate with the fore-and-aft supports to provide a reinforcement for the wall of the arched recess. It will thus be evident that the total weight of the loaded box will be equally imposed, transversely, upon the two beams **25**, as they are equally spaced from the transverse center of the machine, and that the load imposed on each beam will be equally distributed to the two wheels mounted on it, as the wheels are free to oscillate or rock in a transverse vertical plane about the bearing centers of each beam. In short, if the gross weight of the machine is fifty tons (as in the tested pilot model) the ground pressure exerted by each tire will remain constant at approximately twelve and one-half tons per tire irrespective of anticipated ground contour irregularities. It will also be evident that since the wheels are disposed in a line substantially under the center (longitudinally) of load gravity, the ground surface pressure will be much more concentrated than if the load were carried between front and rear supporting wheels.

To produce the most effective compaction, in a single wheel series machine, it is recognized that the great weight required must not only be concentrated in a single transverse strip and equally distributed to the four wheels, but also that the wheels must be very close together in order to best utilize the combined down pressures and prevent the vertical compaction movement from escaping in the form of upward squeezing of soil between the wheels.

Our wheel mounting is such that the transverse space between the tires of each pair need be very little greater than the thickness of the oscillating or rocking beam **25** and the space between the tires C and D can be as narrow as the spaces between tires B—C or D—E. The effectiveness of this arrangement is illustrated in Fig. 3, where diverging dotted lines **27** indicated how the lateral dispersion of vertical pressures are coordinated so that the actual result is virtually the same as if the tires were immediately adjacent to each other, the intervening spaces being much too narrow to permit the upward escape of any appreciable compaction pressures. To the best of our knowledge no one has previously designed a machine that will thus concentrate compaction pressures while also equally distributing the weight to wheels that will accommodate themselves to irregular terrain. In this connection it may be noted that since the tires employed are of unusually large dimensions (outer diameter of five feet or over) the wheel axles cannot be mounted in vertically depending brackets if the wheels are to have both the required proximity and freedom for oscillation, as such brackets would interfere with such relationship and action. As the wheels are independently rotatable the entire machine can be turned in short radius, and the large tire diameters also insure that even soft ground will be rolled down and not pushed in a wave in advance of the wheels. Our experience indicates that within practicable size limits a machine embodying this invention is required to have not more nor less than four compaction tires.

It is understood that suitable changes or modifications may be made in the design and details of construction as herein disclosed, provided such changes or modifications come within the spirit and scope of the appended claims. Having now therefore fully illustrated and described the preferred embodiments of our invention what we claim to be new and desire to protect by Letters Patent is:

1. An earth compaction roller comprising a hollow body member adapted to receive weight producing ballast and having a transversely extending arched recess between its front and rear ends, an axially aligned series of pneumatic tired wheels mounted in said recess to support the

body member with its center of gravity substantially over the wheels, and a draft beam extending longitudinally through the lower part of the body, centrally thereof, said draft beam traversing said arched recess between two of such wheels and rigidly connecting opposite wall portions of the recess.

2. An earth compaction roller comprising a unitary hollow body member adapted to receive weight producing ballast and having a transversely extending arched recess substantially midway its front and rear ends, two pair of pneumatic tired wheels mounted in said recess, one pair under each half portion thereof, to support the body member with its longitudinal center of gravity substantially over the wheels and so the entire weight of the body will be transversely distributed to both pairs of wheels, a shaft in the recess mounting each pair of said wheels, a fore-and-aft extending support for each shaft positioned between each pair of wheels with each support oscillatably mounted whereby the wheels of each pair have freedom for oscillating movement with respect to its side of the body member and bearings for the fore-and-aft supports disposed at the lower ends of the arched recess, said supports maintaining the lower ends of the recess wall in parallelism.

3. An earth compaction roller comprising a unitary hollow body member forming a single frame and adapted to receive weight producing ballast, said body having a recess extending transversely thereunder, and across its entire width, four pneumatically tired wheels coaxially disposed in said recess, two under each side of the body member, said wheels being mounted in pairs, a shaft in the recess for mounting each pair of wheels, a fore-and-aft extending support in the recess for each shaft positioned between the wheels of each pair with the support oscillatably mounted and with its axis fixed with respect to the body member, whereby the wheels of each pair are free to oscillate about the axis of said supports, and a bearing beam disposed at each lower end of the transverse recess and in which the fore-and-aft supports are mounted, the wheel supporting shafts being parallel with and equidistantly spaced from said bearing beams, the entire imposed load of the body member and its ballast being transmitted equally to the four wheels, the wheels being spaced from each other and with the spacing between each two adjacent wheels being equal whereby the load supporting tires will compact the earth in four equally spaced paths and with equally distributed pressure on each path.

4. An earth compaction roller comprising a unitary hollow body member forming a single frame and adapted to receive weight producing ballast, said body having a recess extending transversely thereunder, and across its entire width, four pneumatically tired wheels coaxially disposed in said recess, two under each side of the body member, said wheels being mounted in pairs, a shaft in the recess for mounting each pair of wheels, a fore-and-aft extending support in the recess for each shaft positioned between the wheels of each pair with the support oscillatably mounted and with its axis fixed with respect to the body member, whereby the wheels of each pair are free to oscillate about the axis of said support, reinforcing means at the lower ends of the transverse recess and in which the support is mounted with the supports acting to maintain said lower ends in parallelism and in spaced relation, the entire imposed load of the body member and its ballast being transmitted equally to the four wheels, the wheels being spaced from each other and with the spacing between each two adjacent wheels being equal whereby the load supporting tires will compact the earth in four equally spaced paths and with equally distributed pressure on each path, and the spacing between the treads of each two adjacent tires being substantially less than the width of the tread of either of such tires whereby the compaction forces will not exert any substantial movement of earth material upwardly between the tires.

CHESTER W. BROS.
ARCHIE O. WILLIAMSON.
ULYSS O. GUIGNARD.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,256,594	Ingram	Sept. 23, 1941
2,295,645	Flynn	Sept. 15, 1942
2,336,814	Suter	Dec. 14, 1943
2,510,817	Greiner et al.	June 6, 1950

OTHER REFERENCES

Engineering News-Record, June 11, 1936, page 835.

Roads and Streets, January 1948, pages 82, 83 and 84.